THE NATIONAL AGRICULTURE IMAGERY PROGRAM

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ABSTRACT

Implementation of a Geographic Information System (GIS) is a major component of the USDA Service Center Modernization Plan. When used in conjunction with the vast amount of land and customer information already available, it provides the ability to effectively administer farm programs, and geo-reference natural disasters and animal or plant disease outbreaks to support better decision making. The USDA Farm Service Agency (FSA), Aerial Photography Field Office (APFO) has provided analog aerial photography to Service Centers for over 60 years, and is now in the process of providing digital imagery for GIS implementation to the approximately 2,500 Service Centers nationwide. This paper describes the planned migration to a new National Agriculture Imagery Program (NAIP). The program's goal is to acquire imagery annually over large parts of the contiguous 48 states, and deliver it to users within a few months time frame. This imagery will meet the needs of two primary requirements within USDA: Provide quick turn-around imagery to Service Centers for mandated annual compliance review; and when orthorectified, become the updated image base layer for GIS. This is a national program with new opportunities for state government participation and partnering.

INTRODUCTION

USDA Service Centers have historically had two analog aerial photography based requirements: (1) Scaled and rectified aerial photo enlargements used to delineate and measure farm field boundaries and assist maintenance of attributed data related to owner/producers; (2) Annual color aerial photography for FSA farm program compliance monitoring flown during the peak growing seasons with 35mm color slides. USDA Service Centers have historically met their requirements with these analog aerial photography formats. However, the migration of USDA program management to a GIS environment has created a need for digital imagery. The National Agriculture Imagery Program (NAIP) is designed to satisfy that need by providing FSA with color digital imagery for the annual compliance program every year, and also provide USDA Service Center agencies with current replacement orthophotography base imagery on a 5 year cycle.

BACKGROUND

Since the 1930's, the USDA FSA (previously know as ASCS) has relied on aerial photography enlargements (photomaps) to accomplish their farm program management requirements. These photomaps were produced by the Aerial Photography Field Office(s)[1]. The photomaps were 24" by 24" black and white scaled enlargements, printed on specially produced Kodak©1594 paper. All photomaps were produced from aerial photography acquired by precision aerial mapping cameras. Millions of these photomaps have been produced over the decades, with many of them still in use. Over the years the

[1] There were two USDA aerial photo labs in existence until 1976, an eastern lab located in Asheville, North Carolina, and a western lab located in Salt Lake City, Utah. Both facilities were consolidated into one Aerial Photography Field Office, in Salt Lake City, in 1976.

photomap product has changed as a result of the source imagery. Source imagery[2] was flown at various photographic scales with different types of films, generally black & white or color infrared, throughout the photomap history. The purpose of the photomap was to provide an accurate geospatial record of farm tract and field boundaries and acreages. The tract and field boundary information was delineated on the photomaps with ink lines and notes, and measured with planimeters, which were linked to tabular data regarding producer information.

With these photomaps as a base image for determining farm program sign-ups, the 35mm slide compliance program was used to verify whether producers were complying with the program they had signed up for. Farm programs are generally for commodity planning, crop insurance, or other resource management programs. The 35mm color slides were flown during the periods when crops could be identified, or damage detected. These slides would be acquired by the USDA Service Centers through contracts with local vendors. Flights were usually scheduled once during the year but would also be flown as many as two or three times in certain areas. The resulting color slides would be projected over the associated photomap for crop acreage verification and farm program compliance.

NAIP PILOT PROJECTS

NAIP is the result of several pilot projects designed to test the feasibility of different imagery sources for the FSA's digital imagery requirements. Those pilot projects included small format digital cameras, scanned 35mm color slides, satellite imagery, and large format mapping cameras.

The small format digital cameras were used in the acquisition of imagery during the summer months of 2001 for a large portion of Minnesota. Four contractors were selected under a competitive procurement administered by APFO and were able to complete the 83 counties covering 64,156 square miles. Although the geo-rectified imagery was of good quality for the most part, the handling of hundreds of small image tiles became arduous.

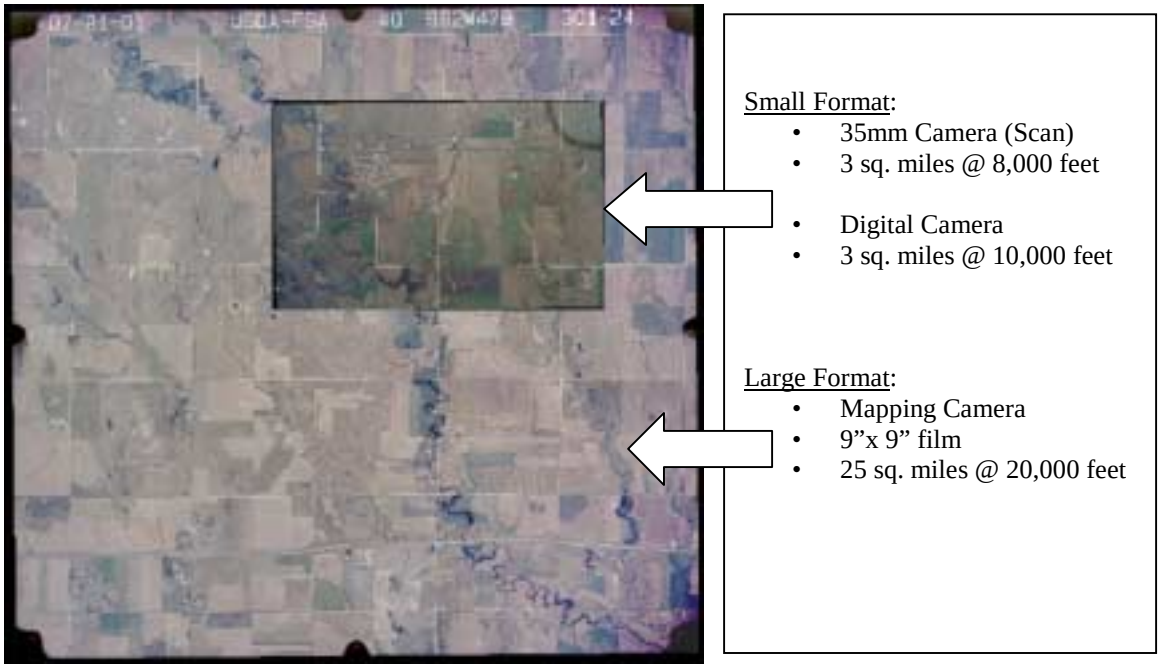
The feasibility of using scanned 35mm color slides was tested and evaluated at APFO. Compliance slides from four counties located in Virginia, Minnesota, and Missouri were scanned and geo-referenced as part of the test. This product was very economical to produce from the existing slides. The image quality was fair but there was still the issue of many small image tiles to manage.

The FSA Washington DC staff investigated the use of satellite imagery to meet FSA's imagery requirements. Several sources were evaluated in terms of image resolution, cloud cover, cost, and licensing. Although the image resolution met FSA's requirements, the other three elements did not. The cloud cover specification was unacceptable, cost was high, and licensing restrictions prohibited placing imagery in public domain.

The final pilot project was conducted using large format (9"x9" frame, 6" focal length) mapping cameras, flown at 1:40,000 scale, quarter quadrangle centered format (QQC), with color positive film. APFO contracted for 51 counties covering 34,960 square miles in Kansas and Nebraska. The contract called for a 2 meter geo-rectified product delivered in a county based format. The flights were performed during July and August of 2001. The contractor performing the work delivered an ortho-rectified 2 meter product that exceeded FSA's minimum requirements.

The large format mapping camera product resulted in a superior rating in the final evaluation and analysis of all the pilot projects. It provided the most economical solution and highest quality product primarily because of the increased area coverage of each photographic frame, the photo resolution, and the orthophoto end product. See Format Comparison Graphic.

[2] Photomap source imagery was flown at various photographic scales including 1:20,000 (ASCS County Photography) during the period of 1938 - 1979, high altitude scales of 1:60,000 and 1:80,000 (National High Altitude Program – NHAP) during the period of 1980-1987, and 1:40,000 scale (National Aerial Photography Program – NAPP) during the period of 1987 to the present.



Format Comparison Graphic

NAIP PRODUCT DESCRIPTION AND PURPOSE

Based on the results of the pilot projects, it was determined the imagery from the large format mapping camera best met FSA's imagery requirements. From the 9”x9” aerial film, two products can be derived depending on specific requirements of any given area. First, to meet FSA's compliance program, a two meter resolution, rectified digital image can be provided; Second, to meet FSA's orthophoto base layer update for GIS, a certified one meter ortho-rectified digital image can be provided.

The two meter compliance product is refered as an 'ortho-lite' digital image scanned at a 50 micron resolution, with horizontal and vertical control being accomplished with airborne global positioning system (ABGPS) and an inertial management unit (IMU) system. The aerotriangulation solution, as well as the digital elevation modeling is one that usually requires less computer processing time than a certified one meter orthophoto. The USDA contract specification for accuracy of this product is currently based on an area accuracy of plus or minus 5% when compared to the Mosaicked Digital Orthophoto Quadrangles (MDOQs). MDOQs are used APFO for quality control in the inspection process, and by the USDA Service Centers as the GIS ortho-base image layer.

The one meter GIS ortho-base update product (second generation digital orthophoto) is defined as a certified orthophoto digital image scanned at a 25 micron resolution, with horizontal and vertical control being accomplished with airborne global positioning system (ABGPS) and an inertial management unit (IMU) system. Additional accuracy specifications require the orthophoto to have a relational horizontal accuracy of plus or minus 3 meters when compared to the existing MDOQs of that particular county. The aerotriangulation solution, as well as the digital elevation modeling is one that is far more robust than the solution for an ortho-lite product.

The purpose of NAIP is to provide USDA Service Centers, as well as cost-sharing partners, current and timely digital imagery. The two meter ortho-lite product is the primary compliance program imagery, however, both the one and two meter imagery can be used by FSA personnel to perform their compliance program tasks. The primary purpose of the one meter imagery is to update the GIS orthophoto base layer. The imagery is required to be delivered by the contractors in a county format on compact disks (CDs). The imagery contained on the CDs is loaded onto APFO's library for inspection and archiving purposes, and the CDs forwarded on to the user. The CDs are required to be delivered within 30 days of the end of the flying season, generally ending around August 31st. Both the one and two meter products meet all FGDC metadata requirements which are provided as a deliverable under the contract.

NAIP 2002 – THE INAUGURAL YEAR

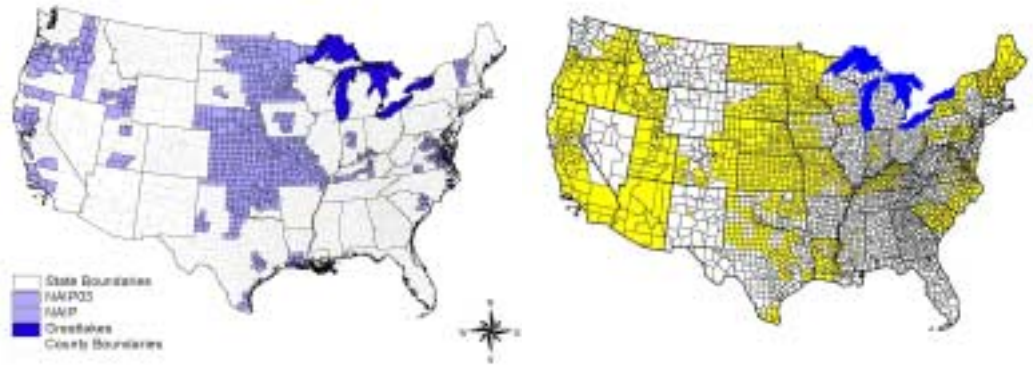
The NAIP contracts awarded in 2002 covered portions of six states: Minnesota, North & South Dakota, Nebraska, Kansas, and Missouri (See Map). Four contractors were awarded contracts to acquire and process imagery for 121 counties covering 82,727 square miles. Almost 29,000 linear miles of 1:40,000 QQC aerial photography was flown within a brief period of 60 days during July and August of 2002. The contract covering Minnesota required the one meter ortho-rectified product and was awarded at the price of $18.99 per square mile. The other three contracts covering the remaining states required a two meter geo-rectified product and were awarded at an average price of $6.94 per square mile. All the contracts were completed and delivered in accordance with contract requirements.

Coverage selection of the 2002 contracted counties was based in part on the following general criteria: The GIS and related hardware/software must be in place, the county must have MDOQs, and the Common Land Unit (CLU) boundaries must be digitized. If the county met these requirements, then that county was selected for new NAIP imagery. The decision of which product to purchase, one meter or two meter, was based on the age of existing MDOQs in that county.

NAIP 2003 AND FUTURE YEAR PLANS

Future plans for the National Agriculture Imagery Program are being prepared. Coverage selection is based on an extensive list of criteria, including the prerequisites mentioned above. One additional element used in the actual flight selection process is the extent of agricultural land within a county. If there is less than 50% agricultural land, then only that land is selected for NAIP coverage. The following maps show the potential coverage of NAIP contracts for Fiscal Years 2003 and 2004.

FY2003 FY2004



The potential coverage represented above is only an estimate as of February 2003. Actual coverage selected and awarded to contractors may vary greatly from what is shown.

NAIP PARTNERSHIP OPPORTUNITIES

The Farm Service Agency is actively seeking partners that would benefit in cost share agreements. Potential partners may be looking for additional new coverage beyond FSA counties, new coverage beyond agricultural areas of a county, or higher image resolution upgrade. The FSA Aerial Photography Field Office is in the process of drafting and negotiating cost share agreement terms with various agencies. If your agency is interested in partnering, please contact FSA by telephone: (801) 975-3500 ext. 208, or email: contracts@apfo.usda.gov.